



# Product Specifications

PART NO:

**VL378T2953B-E6/D5/CC**

**REV: 1.1**

## General Information

### 1GB 128Mx64 DDR2 SDRAM UNBUFFERED 240 PIN DIMM

**Description:** The VL378T2953B is a 128M X 64 DDR2 SDRAM high density DIMM. This memory module consists of sixteen CMOS 64MX8 bit with 4 banks DDR2 Synchronous DRAMs in BGA packages, and a 2K EEPROM in 8-pin TSSOP package. This module is a 240-pin Dual-In line-Memory Module and is intended for mounting into a connector socket. Decoupling capacitors are mounted on the printed circuit board for each DDR2 SDRAM.

### Features:

- . 240 -pin, dual-in line memory module (DIMM)
- . Fast data transfer rate s: PC2-5300, PC2-4200, and PC2-3200
- . VDD = VDDQ = 1.8V
- . VDDSPD = 1.7V to 3.6V
- . JEDEC standard 1.8V I/O (SSTL\_18 compatible)
- . Differential data strobe (DQS, DQS# ) option
- . Four-bit prefetch architecture
- . DLL aligns DQ and DQS transition with CK
- . Programmable CAS# Latency (CL): 3, 4 & 5
- . Write latency = Read latency - 1 tCK
- . Programmable Burst ; length (4, 8)
- . Adjustable data-output drive strength
- . On-die termination (ODT)
- . Auto & Self refresh, (8K/64ms refresh)
- . Serial presence detect with EEPROM
- . Gold egde contacts
- . Lead-free RoHS
- . PCB: **Height 30mm (1.181")**

Pin Name	Function
A0~A13	Address Inputs
BA0 ~ BA1	Bank Address Inputs
DQ0 ~ DQ63	Data Input/Output
DQS0 ~ DQS7	Data Strobes
DQS0# ~ DQS7#	Data Strobes Complement
ODT0,ODT1	On-die Termination Control
CK0,CK0# ~ CK2,CK2#	Differential Clock Input
CKE0,CKE1	Clock Enables
CS0#,CS1#	Chip Selects
RAS#	Row Address Strobes
CAS#	Column Address Strobes
WE#	Write Enable
VDD	Voltage Supply 1.8V +/- 0.1V
VDDQ	I/O Power 1.8V +/- 0.1V
VSS	Ground
SA0~SA2	SPD Address
SDA	SPD Data Input/Output
SCL	SPD Clock Input
DM0~DM7	Data Masks
A10/AP	Address input/Autoprecharge
VREF	SSTL_18 Reference Voltage
VDDSPD	SPD Voltage supply 1.7V to 3.6V
NC	No Connect

### Order Information :

**VL378T2953B-E6 S**

DRAM MANUFACTURER  
S - SAMSUNG  
M - MICRON

MODULE SPEED  
E6: PC5300 @ CL5  
D5: PC4200 @ CL4  
CC: PC3200 @ CL3

VL : Lead-free/RoHS



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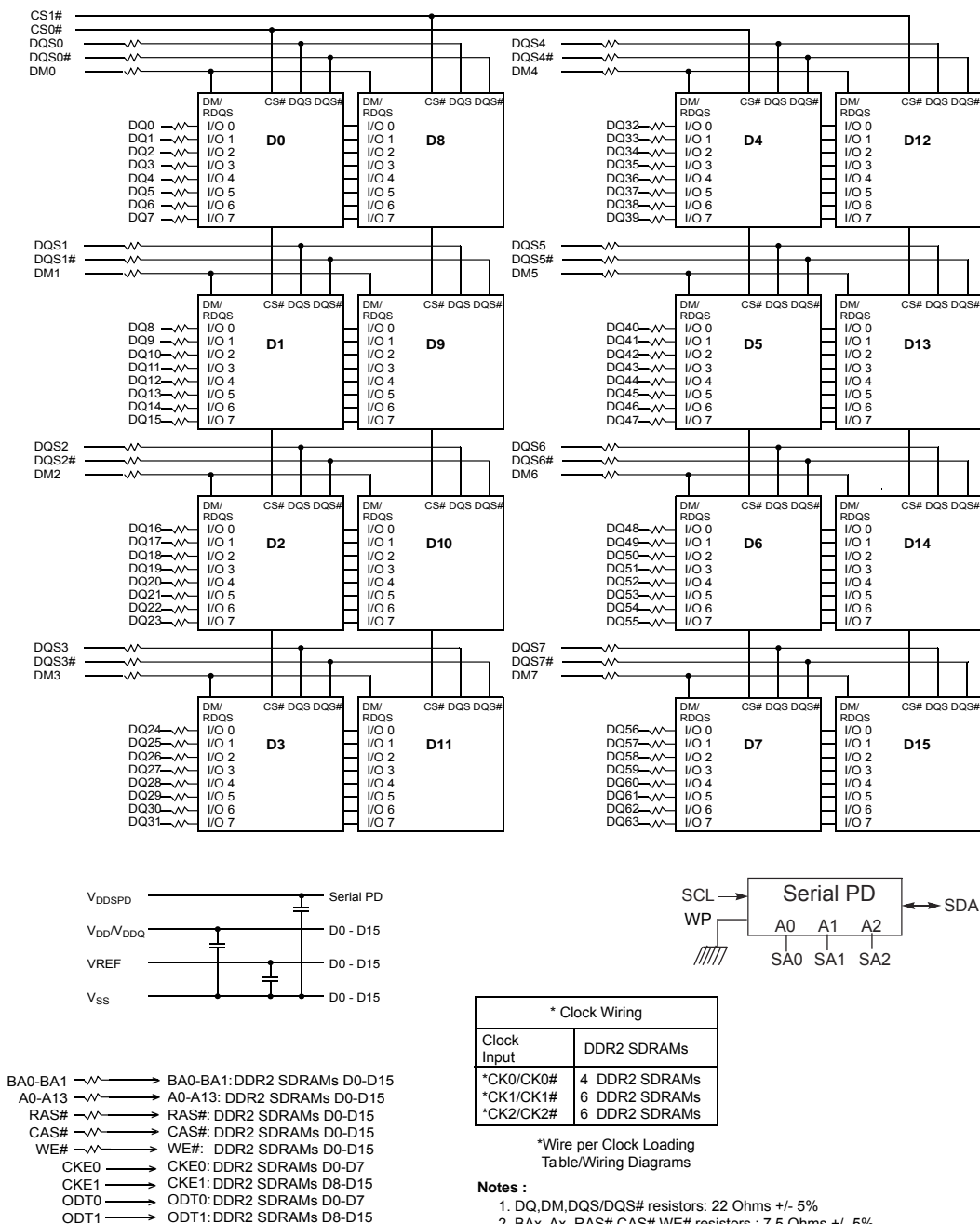
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## Pin Configuration

240-PIN DDR2 DIMM FRONT								240-PIN DDR2 DIMM BACK							
Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name		
1	VREF	31	DQ19	61	A4	91	VSS	121	VSS	151	VSS	181	VDDQ	211	DM5
2	VSS	32	VSS	62	VDDQ	92	DQS5#	122	DQ4	152	DQ28	182	A3	212	NC
3	DQ0	33	DQ24	63	A2	93	DQS5	123	DQ5	153	DQ29	183	A1	213	VSS
4	DQ1	34	DQ25	64	VDD	94	VSS	124	VSS	154	VSS	184	VDD	214	DQ46
5	VSS	35	VSSD	65	VSS	95	DQ42	125	DM0	155	DM3	185	CK0	215	DQ47
6	DQS0#	36	DQS3#	66	VSS	96	DQ43	126	NC	156	NC	186	CK0#	216	VSS
7	DQS0	37	DQS3	67	VDD	97	VSS	127	VSS	157	VSS	187	VDD	217	DQ52
8	VSS	38	VSS	68	NC	98	DQ48	128	DQ6	158	DQ30	188	A0	218	DQ53
9	DQ2	39	DQ26	69	VDD	99	DQ49	129	DQ7	159	DQ31	189	VDD	219	VSS
10	DQ3	40	DQ27	70	A10/AP	100	VSS	130	VSS	160	VSS	190	BA1	220	CK2
11	VSS	41	VSS	71	BA0	101	SA2	131	DQ12	161	CB4*	191	VDDQ	221	CK2#
12	DQ8	42	CB0*	72	VDDQ	102	NC	132	DQ13	162	CB5*	192	RAS#	222	VSS
13	DQ9	43	CB1*	73	WE#	103	VSS	133	VSS	163	VSS	193	CS0#	223	DM6
14	VSS	44	VSS	74	CAS#	104	DQS6#	134	DM1	164	DM8*	194	VDDQ	224	NC
15	DQS1#	45	DQS8#*	75	VDDQ	105	DQS6	135	NC	165	NC	195	ODT0	225	VSS
16	DQS1	46	DQS8	76	CS1#	106	VSS	136	VSS	166	VSS	196	A13	226	DQ54
17	VSS	47	VSS	77	ODT1	107	DQ50	137	CK1	167	CB6*	197	VDD	227	DQ55
18	RESET#*	48	CB2*	78	VDDQ	108	DQ51	138	CK1#	168	CB7*	198	VSS	228	VSS
19	NC	49	CB3*	79	VSS	109	VSS	139	VSS	169	VSS	199	DQ36	229	DQ60
20	VSS	50	VSS	80	DQ32	110	DQ56	140	DQ14	170	VDDQ	200	DQ37	230	DQ61
21	DQ10	51	VDDQ	81	DQ33	111	DQ57	141	DQ15	171	CKE1	201	VSS	231	VSS
22	DQ11	52	CKE0	82	VSS	112	VSS	142	VSS	172	VDD	202	DM4	232	DM7
23	VSS	53	VDD	83	DSQ4#	113	DQS7#	143	DQ20	173	NC	203	NC	233	NC
24	DQ16	54	BA2*	84	DSQ4	114	DQS7	144	DQ21	174	NC	204	VSS	234	VSS
25	DQ17	55	NC	85	VSS	115	VSS	145	VSS	175	VDDQ	205	DQ38	235	DQ62
26	VSS	56	VDDQ	86	DQ34	116	DQ58	146	DM2	176	A12	206	DQ39	236	DQ63
27	DQS2#	57	A11	87	DQ35	117	DQ59	147	NC	177	A9	207	VSS	237	VSS
28	DQS2	58	A7	88	VSS	118	VSS	148	VSS	178	VDD	208	DQ44	238	VDDSPD
29	VSS	59	VDD	89	DQ40	119	SDA	149	DQ22	179	A8	209	DQ45	239	SA0
30	DQ18	60	A5	90	DQ41	120	SCL	150	DQ23	180	A6	210	VSS	240	SA1

\* These pins are not used in this module.

## Functional Block Diagram





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## Absolute Maximum Ratings

Symbol	Parameter	MIN	MAX	Unit	
V <sub>DD</sub>	Voltage on V <sub>DD</sub> pin relative to V <sub>SS</sub>	-1.0	2.3	V	
V <sub>DDQ</sub>	Voltage on V <sub>DDQ</sub> pin relative to V <sub>SS</sub>	-0.5	2.3	V	
V <sub>DDL</sub>	Voltage on V <sub>DDL</sub> pin relative to V <sub>SS</sub>	-0.5	2.3	V	
V <sub>IN</sub> , V <sub>OUT</sub>	Voltage on any pin relative to V <sub>SS</sub>	-0.5	2.3	V	
T <sub>STG</sub>	Storage temperature	-55	100	°C	
T <sub>CASE</sub>	Device operating Temperature	0	85	°C	
I <sub>L</sub>	Input leakage current; Any input 0V<V <sub>IN</sub> <V <sub>DD</sub> ; V <sub>REF</sub> input 0V<V <sub>IN</sub> <0.95V; Other pins not under test = 0V	Command/Address, RAS#, CAS#, WE#	-80	80	µA
		CS#, CKE	-40	40	µA
		CK, CK#	-30	30	µA
		DM	-10	10	µA
I <sub>OZ</sub>	Output leakage current; 0V<V <sub>OUT</sub> <V <sub>DDQ</sub> ; DQs and ODT are disable	-10	10	µA	
I <sub>VREF</sub>	V <sub>REF</sub> leakage current; V <sub>REF</sub> = Valid V <sub>REF</sub> level	-32	32	µA	

## DC Operating Conditions

All voltages referenced to V<sub>SS</sub>

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Supply voltage	V <sub>DD</sub>	1.7	1.8	1.9	V	1
I/O Supply voltage	V <sub>DDQ</sub>	1.7	1.8	1.9	V	4
VDDL Supply voltage	V <sub>DDL</sub>	1.7	1.8	1.9	V	4
I/O Reference voltage	V <sub>REF</sub>	0.49 x V <sub>DDQ</sub>	0.50 x V <sub>DDQ</sub>	0.51 x V <sub>DDQ</sub>	V	2
I/O Termination voltage	V <sub>TT</sub>	V <sub>REF</sub> -0.04	V <sub>REF</sub>	V <sub>REF</sub> +0.04	V	3

- Notes:
1. V<sub>DD</sub>, V<sub>DDQ</sub> must track each other. V<sub>DDQ</sub> must be less than or equal to V<sub>DD</sub>.
  2. V<sub>REF</sub> is expected to equal V<sub>DDQ</sub>/2 of the transmitting device and to track variations in the DC level of the same. Peak-to-peak noise on V<sub>REF</sub> may not exceed +/-1percent of the DC value. Peak-to-peak AC noise on V<sub>REF</sub> may not exceed +/-2 percent of V<sub>REF</sub>. This measurement is to be taken at the nearest V<sub>REF</sub> bypass capacitor.
  3. V<sub>TT</sub> is not applied directly to the device. V<sub>TT</sub> is a system supply for signal termination resistors, is expected to be set equal to V<sub>REF</sub> and must track variations in the DC level of V<sub>REF</sub>.
  4. V<sub>DDQ</sub> tracks with V<sub>DD</sub>; V<sub>DDL</sub> track with V<sub>DD</sub>.



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## Operating Temperature Condition

Parameter	Symbol	Rating	Units	Notes
Operating temperature	TOPER	0 to 85	°C	1,2

Notes:

1. Operating temperature is the case surface temperature on the center/top side of the DRAM. For the measurement conditions, please refer to JEDEC JESD51.2
2. At 0 - 85°C, operation temperature range, all DRAM specification will be supported.

## Input DC Logic Level

All voltages referenced to VSS

Parameter	Symbol	Min	Max	Unit
Input High (Logic 1) Voltage	V <sub>IH</sub> (DC)	V <sub>REF</sub> + 0.125	V <sub>REF</sub> + 0.300	V
Input Low (Logic 0) Voltage	V <sub>IL</sub> (DC)	-0.300	V <sub>REF</sub> - 0.125	V

## Input AC Logic Level

All voltages referenced to VSS

Parameter	Symbol	Min	Max	Unit
AC Input High (Logic 1) Voltage DDR2-400 & DDR2-533	V <sub>IH</sub> (AC)	V <sub>REF</sub> + 0.250	-	V
AC Input High (Logic 1) Voltage DDR2-667	V <sub>IH</sub> (AC)	V <sub>REF</sub> + 0.200	-	V
AC Input Low (Logic 0) Voltage DDR2-400 & DDR2-533	V <sub>IL</sub> (AC)	-	V <sub>REF</sub> - 0.250	V
AC Input Low (Logic 0) Voltage DDR2-667	V <sub>IL</sub> (AC)	-	V <sub>REF</sub> - 0.200	V

## Input/Output Capacitance

TA=25°C, f=100MHz

Parameter	Symbol	Min	Max	Unit
Input capacitance (A0~A13, BA0~BA1,RAS#,CAS#,WE#)	CIN1	20	36	pF
Input capacitance (CKE0,CKE1), (ODT0,ODT1)	CIN2	12	20	pF
Input capacitance (CS0#,CS1#)	CIN3	12	20	pF
Input capacitance (CK0, CK0# ~ CK2, CK2#)	CIN4	10	16	pF
Input capacitance (DM0 ~ DM7)	CIN5 (E6)	9	11	pF
	CIN5 (D5,CC)	9	12	pF
Input capacitance (DQ0 ~ DQ63), (DQS0 ~ DQS7)	COUT1 (E6)	9	11	pF
	COUT1 (D5,CC)	9	12	pF



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## IDD Specification

Condition	Symbol	-E6	-D5	-CC	Unit	
<b>Operating one bank active-precharge;</b> $t_{CK} = t_{CK(IDD)}$ ; $t_{RC} = t_{RC(IDD)}$ ; $t_{RAS} = t_{RAS MIN(IDD)}$ ; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING	IDD0*	744	704	704	mA	
<b>Operating one bank active-read-precharge;</b> IOUT = 0mA; BL = 4; CL = CL(IDD); $t_{CK} = t_{CK(IDD)}$ ; $t_{RC} = t_{RC(IDD)}$ ; $t_{RAS} = t_{RAS MIN(IDD)}$ ; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING; Data pattern is same as IDD4W.	IDD1*	864	824	824	mA	
<b>Precharge power-down current;</b> All banks idle; $t_{CK} = t_{CK(IDD)}$ ; CKE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	IDD2P**	128	128	128	mA	
<b>Precharge quite standby current;</b> All banks idle; $t_{CK} = t_{CK(IDD)}$ ; CKE is HIGH; CS# is HIGH; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	IDD2Q**	560	480	480	mA	
<b>Precharge standby current;</b> All banks idle; $t_{CK} = t_{CK(IDD)}$ ; CKE is HIGH; CS# is HIGH; Other control and address bus inputs are STABLE; Data bus inputs are SWITCHING	IDD2N**	640	560	560	mA	
<b>Active power-down current;</b> All banks open; $t_{CK} = t_{CK(IDD)}$ ; CKE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	IDD3P**	Fast PDN Exit MRS(12) = 0	480	480	480	mA
		Slow PDN Exit MRS(12) = 1	192	192	192	mA
<b>Active standby current;</b> All banks open; $t_{CK} = t_{CK(IDD)}$ ; $t_{RC} = t_{RC(IDD)}$ ; $t_{RAS} = t_{RAS MIN(IDD)}$ ; CKE is HIGH, CS# is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING	IDD3N**	880	800	800	mA	
<b>Operating burst write current;</b> All banks open; Continuous burst writes; BL = 4; CL = CL(IDD); AL = 0; $t_{CK} = t_{CK(IDD)}$ ; $t_{RAS} = t_{RAS MAX(IDD)}$ ; $t_{RP} = t_{RP(IDD)}$ ; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING	IDD4W*	1184	1024	944	mA	
<b>Operating burst read current;</b> All banks open; Continuous burst reads; IOUT = 0mA; BL = 4; CL = CL(IDD); AL = 0; $t_{CK} = t_{CK(IDD)}$ ; $t_{RAS} = t_{RAS MAX(IDD)}$ ; $t_{RP} = t_{RP(IDD)}$ ; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data pattern is same as IDD4W.	IDD4R*	1224	1064	944	mA	
<b>Burst auto refresh current;</b> $t_{CK} = t_{CK(IDD)}$ ; Refresh command at every $t_{RFC(IDD)}$ interval; CKE is HIGH; CS# is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING	IDD5**	2400	2240	2240	mA	
<b>Self refresh current;</b> CK and CK# at 0V; CKE < 0.2V; Other control and address bus inputs are FLOATING; Data bus inputs are FLOATING	Normal IDD6**	128	128	128	mA	
<b>Operating bank interleave read current;</b> All bank interleaving reads; IOUT = 0mA; BL = 4; CL = CL(IDD); AL = $t_{RC(IDD)} - 1 * t_{CK(IDD)}$ ; $t_{CK} = t_{CK(IDD)}$ ; $t_{RC} = t_{RC(IDD)}$ ; $t_{RRD} = t_{RRD(IDD)}$ ; $t_{RCD} = 1 * t_{CK(IDD)}$ ; CKE is HIGH; CS# is HIGH between valid commands; Address bus inputs are STABLE during DESELECTs; Data bus inputs are SWITCHING	IDD7*	1824	1824	1824	mA	

Notes: IDDs were calculated using Samsung components. Other manufacturers' DRAMs may have different values.

\*: Value calculated as one module rank in this operating condition, and all other module ranks in IDD2P (CKE LOW) mode.

\*\* : Value calculated reflects all module ranks in this operating condition.



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## AC Timing Parameters & Specifications

Parameter		Symbol	-E6		-D5		-CC		Unit
			Min	Max	Min	Max	Min	Max	
Clock	Clock cycle time	CL=5 $t_{CK}(5)$	3000	8000	-	-	-	-	ps
		CL=4 $t_{CK}(4)$	3750	8000	3,750	8,000	5,000	8,000	ps
		CL=3 $t_{CK}(3)$	5000	8000	5,000	8,000	5,000	8,000	ps
	CK high-level width	$t_{CH}$	0.45	0.55	0.45	0.55	0.45	0.55	$t_{CK}$
	CK low-level width	$t_{CL}$	0.45	0.55	0.45	0.55	0.45	0.55	$t_{CK}$
	Half clock period	$t_{HP}$	MIN ( $t_{CH}, t_{CL}$ )		MIN ( $t_{CH}, t_{CL}$ )		MIN ( $t_{CH}, t_{CL}$ )		ps
	Clock jitter	$t_{JIT}$	-125	125	-125	125	-125	125	ps
Data	DQ output access time from CK/CK#	$t_{AC}$	-450	+450	-500	+500	-600	+600	ps
	Data-out high impedance window from CK/CK#	$t_{HZ}$		$t_{AC}(MAX)$		$t_{AC}(MAX)$		$t_{AC}(MAX)$	ps
	Data-out low-impedance window from CK/CK#	$t_{LZ}$	$t_{AC}(MIN)$	$t_{AC}(MAX)$	$t_{AC}(MIN)$	$t_{AC}(MAX)$	$t_{AC}(MIN)$	$t_{AC}(MAX)$	ps
	DQ and DM input setup time relative to DQS	$t_{DS}$	100		100		150		
	DQ and DM input hold time relative to DQS	$t_{DH}$	175		225		275		
	DQ and DM input pulse width (for each input)	$t_{DIPW}$	0.35		0.35		0.35		$t_{CK}$
	Data hold skew factor	$t_{QHS}$		340		400		450	ps
	DQ-DQS hold, DQS to first DQ to go nonvalid, per access	$t_{QH}$	$t_{HP} - t_{QHS}$		$t_{HP} - t_{QHS}$		$t_{HP} - t_{QHS}$		ps
	Data valid output window (DVW)	$t_{DVW}$	$t_{QH} - t_{DQSQ}$		$t_{QH} - t_{DQSQ}$		$t_{QH} - t_{DQSQ}$		ns
Data Strobe	DQS input high pulse width	$t_{DQSH}$	0.35		0.35		0.35		$t_{CK}$
	DQS input low pulse width	$t_{DQSL}$	0.35		0.35		0.35		$t_{CK}$
	DQS output access time from CK/CK#	$t_{DQSCK}$	-400	+400	-450	+450	-500	+500	ps
	DQS falling edge to CK rising – setup time	$t_{DSS}$	0.2		0.2		0.2		$t_{CK}$
	DQS falling edge from CK rising – hold time	$t_{DSH}$	0.2		0.2		0.2		$t_{CK}$
	DQS-DQ skew, DQS to last DQ valid, per group, per access	$t_{DQSQ}$		240		300		350	ps
	DQS read preamble	$t_{RPRE}$	0.9	1.1	0.9	1.1	0.9	1.1	$t_{CK}$
	DQS read postamble	$t_{RPST}$	0.4	0.6	0.4	0.6	0.4	0.6	$t_{CK}$
	DQS write preamble setup time	$t_{WPRES}$	0		0		0		ps
	DQS write preamble	$t_{WPRE}$	0.35		0.35		0.35		$t_{CK}$
	DQS write postamble	$t_{WPST}$	0.4	0.6	0.4	0.6	0.4	0.6	$t_{CK}$
	Write command to first DQS latching transition	$t_{DQSS}$	WL-0.25	WL+0.25	WL-0.25	WL+0.25	WL-0.25	WL+0.25	$t_{CK}$



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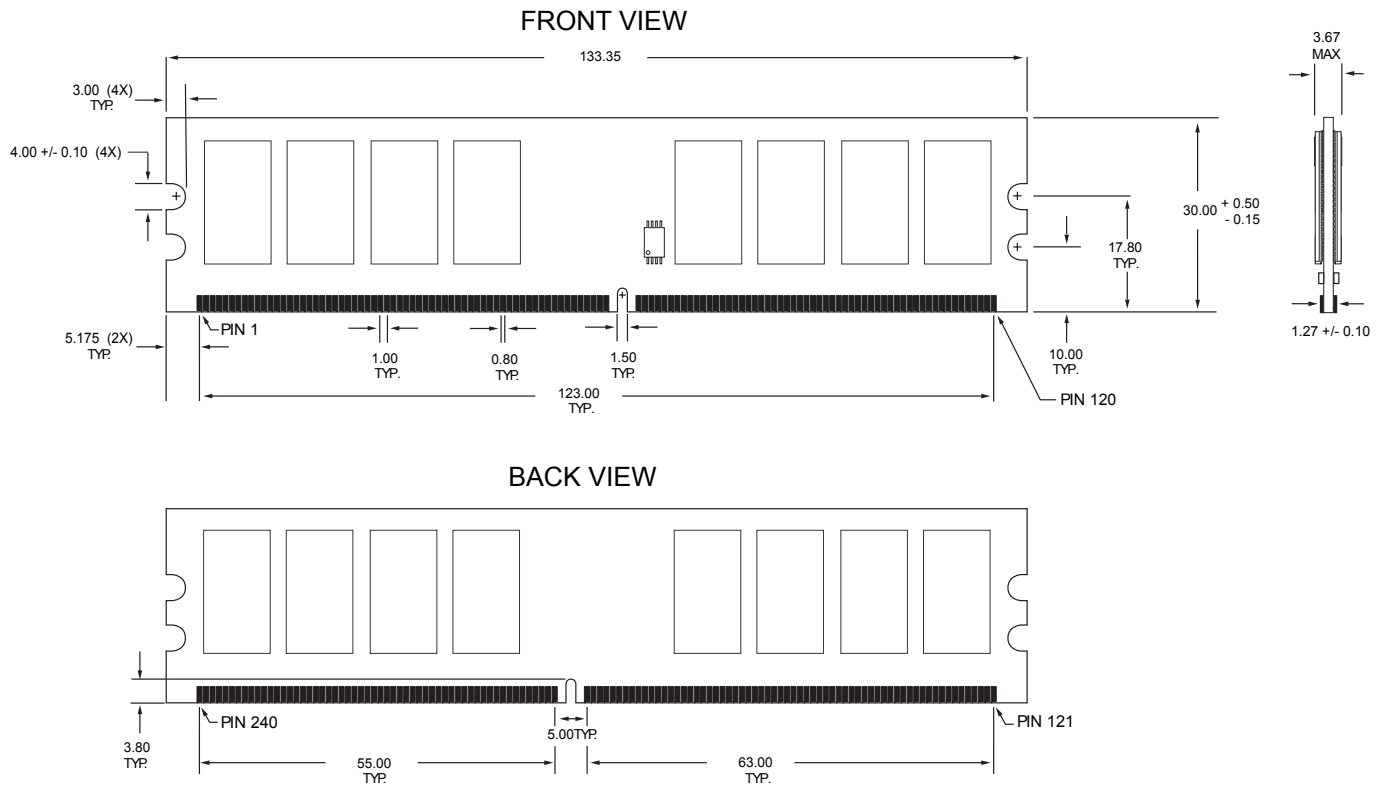
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## AC Timing Parameters & Specifications ( cont')

	Parameter	Symbol	-E6		-D5		-CC		Unit
			Min	Max	Min	Max	Min	Max	
Command and Address	Address and control input pulse width for each input	$t_{PW}$	0.6		0.6		0.6		$t_{CK}$
	Address and control input setup time	$t_{IS}$	200		250		350		ps
	Address and control input hold time	$t_{IH}$	275		375		475		ps
	CAS# to CAS# command delay	$t_{CCD}$	2		2		2		ps
	ACTIVE to ACTIVE (same bank) command	$t_{RC}$	60		60		55		ns
	ACTIVE bank a to ACTIVE bank b command	$t_{RRD}$	7.5		7.5		7.5		ns
	ACTIVE to READ or WRITE delay	$t_{RCD}$	15		15		15		ns
	Four Bank Activate period	$t_{FAW}$	37.5	37.5	37.5	37.5	37.5	37.5	ns
	ACTIVE to PRECHARGE command	$t_{RAS}$	45	70,000	45	70,000	40	70,000	ns
	Internal READ to precharge command delay	$t_{RTP}$	7.5		7.5		7.5		ns
	Write recovery time	$t_{WR}$	15		15		15		ns
	Auto precharge write recovery + precharge time	$t_{DAL}$	$t_{WR} + t_{RP}$		$t_{WR} + t_{RP}$		$t_{WR} + t_{RP}$		ns
	Internal WRITE to READ command delay	$t_{WTR}$	7.5		7.5		10		ns
	PRECHARGE command period	$t_{RP}$	15		15		15		ns
	PRECHARGE ALL command period	$t_{RPA}$	$t_{RP} + t_{CK}$		$t_{RP} + t_{CK}$		$t_{RP} + t_{CK}$		ns
	LOAD MODE command cycle time	$t_{MRD}$	2		2		2		$t_{CK}$
CKE low to CK,CK# uncertainty	$t_{DELAY}$	$t_{IS} + t_{CK} + t_{IH}$		$t_{IS} + t_{CK} + t_{IH}$		$t_{IS} + t_{CK} + t_{IH}$		ns	
Self Refresh	REFRESH to Active or Refresh to Refresh command interval	$t_{RFC}$	105	70,000	105	70,000	105	70,000	ns
	Average periodic refresh interval	$t_{REFI}$		7.8		7.8		7.8	us
	Exit self refresh to non-READ command	$t_{XSNR}$	$t_{RFC(MIN)} + 10$		$t_{RFC(MIN)} + 10$		$t_{RFC(MIN)} + 10$		ns
	Exit self refresh to READ	$t_{XSRD}$	200		200		200		$t_{CK}$
	Exit self refresh timing reference	$t_{ISXR}$	$t_{IS}$		$t_{IS}$		$t_{IS}$		ps
ODT	ODT turn-on delay	$t_{AOND}$	2	2	2	2	2	2	$t_{CK}$
	ODT turn-on	$t_{AON}$	$t_{AC(MIN)}$	$t_{AC(MAX)} + 700$	$t_{AC(MIN)}$	$t_{AC(MAX)} + 1000$	$t_{AC(MIN)}$	$t_{AC(MAX)} + 1000$	ps
	ODT turn-off delay	$t_{AOFD}$	2.5	2.5	2.5	2.5	2.5	2.5	$t_{CK}$
	ODT turn-off	$t_{AOF}$	$t_{AC(MIN)}$	$t_{AC(MAX)} + 600$	$t_{AC(MIN)}$	$t_{AC(MAX)} + 600$	$t_{AC(MIN)}$	$t_{AC(MAX)} + 600$	ps
	ODT turn-on (power-down mode)	$t_{AONPD}$	$t_{AC(MIN)} + 2000$	$2 \times t_{CK} + t_{AC(MAX)} + 1000$	$t_{AC(MIN)} + 2000$	$2 \times t_{CK} + t_{AC(MAX)} + 1000$	$t_{AC(MIN)} + 2000$	$2 \times t_{CK} + t_{AC(MAX)} + 1000$	ps
	ODT turn-off (power-down mode)	$t_{AOFPD}$	$t_{AC(MIN)} + 2000$	$2.5 \times t_{CK} + t_{AC(MAX)} + 1000$	$t_{AC(MIN)} + 2000$	$2.5 \times t_{CK} + t_{AC(MAX)} + 1000$	$t_{AC(MIN)} + 2000$	$2.5 \times t_{CK} + t_{AC(MAX)} + 1000$	ps
	ODT to power-down entry latency	$t_{ANPD}$	3		3		3		$t_{CK}$
	ODT power-down exit latency	$t_{AXPD}$	8		8		8		$t_{CK}$
Power-Down	Exit active power-down to READ command, MR[bit12=0]	$t_{XARD}$	2		2		2		$t_{CK}$
	Exit active power-down to READ command, MR[bit12=1]	$t_{XARDS}$	7-AL		6-AL		6-AL		$t_{CK}$
	Exit precharge power-down to any non-READ command.	$t_{XP}$	2		2		2		$t_{CK}$
	CKE minimum high/low time	$t_{CKE}$	3		3		3		$t_{CK}$

<h1>Product Specifications</h1>		
PART NO:	VL378T2953B-E6/D5/CC	REV: 1.1

## Package Dimensions



**NOTE:**

All dimensions are in millimeters with tolerance +/- 0.13mm unless otherwise specified.



## Product Specifications

PART NO: VL378T2953B-E6/D5/CC

REV: 1.1

### Revision History:

Date	Rev.	Page	Changes
10/03/06	0.1	All	Initial draft
10/12/06	1.0	All	Released spec
07/01/08	1.1	3, 9	Updated Block Diagram page 3 Updated Dimension Package page 9